# Light-emitting Diode (LED) Cap Lamp Research

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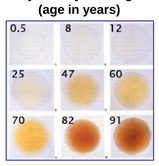
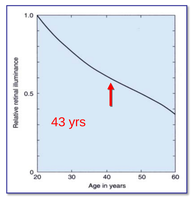
## Background

- 80% of perception is visual.
- Lighting is critical for safety.
- The cap lamp is a miner's primary light source.
- Aging workforce: miner 43 yrs. old (average).
  - retinal illuminance: -40% than 20 yr old.




(Rea, 2000)




(Rea, 2000)

## Objectives

**Reduce Traumatic Injuries involving:**

- Slips/trips/falls
- Moving machinery pining/striking
- Glare
- Age-related vision issues

**Better lighting in smoke to help:**

- Miners escape
- Rescue efforts

## Accidents

- 158,861 slip/trip/fall non-fatal days lost injuries (2003-07)
- 31 pining/striking fatalities (1984-2007, continuous mining machine)

## Results

**No glare issues**
**194% faster floor hazard detection**
**33% - 50% less power than other LED cap lamps**
**79% faster periphery detection to see moving machinery**

**Traditional LED cap lamp (tunnel vision)**

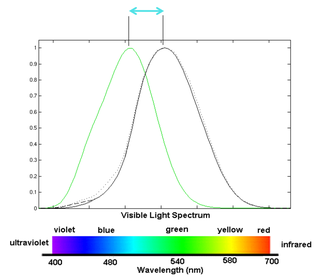
**NIOSH LED cap lamp (light the hazards)**

## Smoke Testing

**The light beam distribution effect on viewing ceiling tags in smoke.**

## Approach

1. **Use the best light color for aging miner**
   - Mining: a low light condition (mesopic)
   - Colors the eye is most sensitive to for mesopic




- **Results due to the color of light:**
  - 53.8% reduced disability glare
  - 15% better peripheral detection
  - 23.7% better floor hazard detection

2. **Illuminate the hazards in the field of view.**
   - Model the field of view.
   - Illuminate the hazards.